

Name _____

PIXE Homework #3 - Physics 100

Union College Fall 2024

Due Date: Friday, September 13, 2024, in lab. **Late assignments are not accepted.**

1. Suppose that your x-ray detector had an energy resolution of $\Delta E = 0.5 \text{ keV}$, would it be able to separate the K_a lines for platinum ($^{195}_{78}\text{Pt}$) and gold ($^{197}_{79}\text{Au}$)? An energy resolution means that anything smaller than this value (0.5 keV), and I won't be able to distinguish the lines as separate from each other. In other words, the lines will overlap. Suppose that you had an x-ray energy spectrum (a graph of the intensity of x-rays versus their energy, as was shown in homework 2) would you be able to tell the K_a line of platinum from the K_a line of gold?

2. Starting with the fact that an emitted x-ray has an energy given by $E = hf$, show that the Moseley's law for a K_a radiative transition may be expressed as

$$\sqrt{f} = \sqrt{\frac{3}{4} \left(\frac{13.6 \text{ eV}}{h} \right)} (Z - 1), \text{ where } f \text{ is the x-ray frequency.}$$

3. Suppose that you did not have a source of protons in which to perform a PIXE experiment. Rather, you had a source of alpha particles (or helium nuclei.) Describe how you could use the alpha particles to do materials identification of an unknown target material. In particular describe the HIXE (which stands for Helium Induced X-ray Emission spectroscopy) process and what the energy formula for the emitted x-rays might look like.